SELF-CLEANSING UNDERGROUND WATER COLLECTING SYSTEM[1]

By George I. Prince[2]

The author was recently called in consultation by the authorities of a western town to overcome a condition which was seriously affecting the public water supply. This supply is obtained by means of a wooden gallery, which is laid below the bed of the North Platte River, and extends under the river bed for a distance of about 600 feet from the east bank. It is of square cross-section, 36 inches by 36 inches inside dimensions, made up of 2 by 4-inch planks spaced about $\frac{5}{8}$ inches apart.

The water and the material surrounding this collecting box or gallery are of such a chemical nature as to form over and around the gallery an almost impervious curtain which tends to cut off the infiltration of the water supply. Relief has been obtained by periodically excavating the incrusted material which has formed about the gallery, but the relief is only temporary, as the cementing process again occurs within a few weeks. Another city located to the west on the same river is experiencing similar trouble due to the cementing qualities of the material of the river bed in conjunction with the hard water. The author has thought that a statement relating to this particular problem, embodying the method that is proposed to afford the relief desired and insure a constant and abundant water supply, may be of interest.

Not only has this particular gallery above referred to suffered because of the cementing qualities of the surrounding materials, but it was found on examination that considerable quantities of gravel and sand obtained entrance to the interior of the gallery and subsequently to the suction well with which it is connected, thus evidencing improper construction.

An analysis of the water supply indicated serious contamination and at the time the author was called into consultation there was a

[1] Read before the Iowa Section November 5, 1920. Discussions are invited and should be sent to the Editor.

[2] Consulting Engineer, 401 Peters Trust Building, Omaha, Neb.

number of cases of typhoid in the town. An emergency chlorinator was installed at once, with favorable results. The threatened epidemic died out. Since that time the town, on the author's recommendation, has purchased a permanent chlorinating equipment.

It is deemed essential to construct another water collecting system, to be located at a point under the river north and above a creek which discharges considerable sewage contamination into the river about a quarter of a mile above the existing gallery.

The new construction proposes a new pumping station on the east bank of the river about 250 feet east from the new water collecting system. Near this pumping station a suction well will be constructed from which a 14-inch cast-iron supply main will extend west and connect with the connecting pipe or back-bone of the water-collecting system.

The flow of the river at the location of the collecting system is from north to south. The Pathfinder Dam, constructed by the Federal Government, is located on the river something over 100 miles to the north. During the fall and winter months, this dam stores water and the stage of the water in the river below the dam is low until the irrigation season opens in the spring. It is therefore proposed to construct this collecting system during the time of low water.

The proposed collecting system will consist of a 14-inch cast-iron connecting pipe with tight joints, laid for a distance of about 900 feet in a north and south direction parallel with and within 50 feet of the east water line of the river at its low stage. The supply main extending west from the suction well, located on the east bank of the river, will connect with this connecting pipe, near its south end.

It is proposed to insert in this connecting main at intervals of 100 feet, a cast-iron special Y casting, the branch opening of which will be fitted with a flange, to which an 8-inch flange valve will be bolted.

The river bed at this particular location resembles a beach, consisting of excellent building sand underlaid with washed gravel varying in size from $\frac{1}{2}$-inch to 8-inch. The elevation of this river bed along the line of the connecting pipe varies from 83 at south end to 84 at north end, and the elevation of the flow line of the connecting pipe will vary from 74 at the south end to 75 at the north end.

Extreme low water is assumed to be 80 or 4 feet below the river bed at the south end of the collecting system. Under usual conditions the elevation of the river water during the non-irrigation season, from September 15 to March 15, will approximate 82.5.

Examinations which have been made of the sub-soil at the proposed location of the collecting system indicate conditions to exist at this point similar to what exists throughout the entire Platte River basin; namely a very large under-ground flow of water.

Attached to each of the ten 8-inch valves above referred to, there will be bolted three 12-foot lengths of 8-inch flange cast-iron pipe, which will be laid on the lines of the angle of the Y connections.

Each of these flange pipes will be drilled with three lines of one-inch holes, 50 holes in each of the pipes, equally spaced and staggered. The extreme end of each branch line will be closed by a blank flange.

Each branch line will be laid for its length of 36 feet at same elevation as its connecting Y special in a trench not less than 46 inches in width at the bottom. The trench will be excavated to a depth of at least 12 inches below the pipe and refilled with washed gravel, no piece of which will be less than 2 inches in dimension, the larger particles being placed next to the pipe. On either side of the flange pipe for a width of 18 inches and on top to a depth of 4 feet, washed gravel of like character to that below the pipe will be placed and above this the trench may be filled with excavated material.

Around each 8-inch valve there will be built a concrete manhole, the top of which will be at elevation 90 or about 2 feet above high water in the river. These manholes will not be subjected to ice-flow as the river is at its low stage during the winter months. These 8-inch valves will be built with rising stems, the floor standards and hand-wheels being erected upon the concrete covers and housed in as a protection against the weather.

In the pump house there will be installed centrifugal pumps belt-driven by oil engines. The discharge from the pumps will pass south through a 12-inch cast-iron pipe line for a distance of about 1600 feet, at which point it will connect with two existing force mains which are laid to two distributing reservoirs located on high ground east of the town.

To guard against the evils incident to the stoppage of infiltration of underground water caused by the cementing process above referred to and insure a constant and abundant supply of water, it

is proposed to employ a reverse current of water, through a by-pass pipe connecting the discharge and supply mains, under a static head of 220 feet. About once a week all of the ten 8-inch valves on the branches of the collecting system will be closed, after which each valve will be opened successively for such length of time as to allow the reverse flow from the reservoir to effectually wash out and remove all matter of a clogging nature that has accumulated around and above the branch pipe.

Assuming the pipe conditions to be such that 3000 gallons of reverse flow per minute can be delivered to each branch pipe line under a dynamic head of 70 feet, it is evident that each of the 150 holes, in the branch pipe line, would have to pass 20 gallons of water per minute requiring a velocity through the holes of 8.16 feet per second. If we assume 0.5 as the value of the coefficient of discharge, C, in the formula $V = C\sqrt{2GH}$ and assume H to have a value of 70 feet, the formula would indicate a velocity of 32.4 feet per second. Just how much the velocity would be retarded by the gravel filling around the branch pipe lines is indeterminate, but the above figures would indicate a reduction in pressure of 75 per cent due to the surrounding gravel mass.

It is believed that the resulting velocity of the reverse flow through the surrounding gravel mass will be sufficient to thoroughly cleanse it of all the clogging matter that may have collected therein and restore normal condition.

Such is a brief statement of the problem in hand and it is hoped to obtain the opinion of those present as to the wisdom and adequacy of the proposed solution.